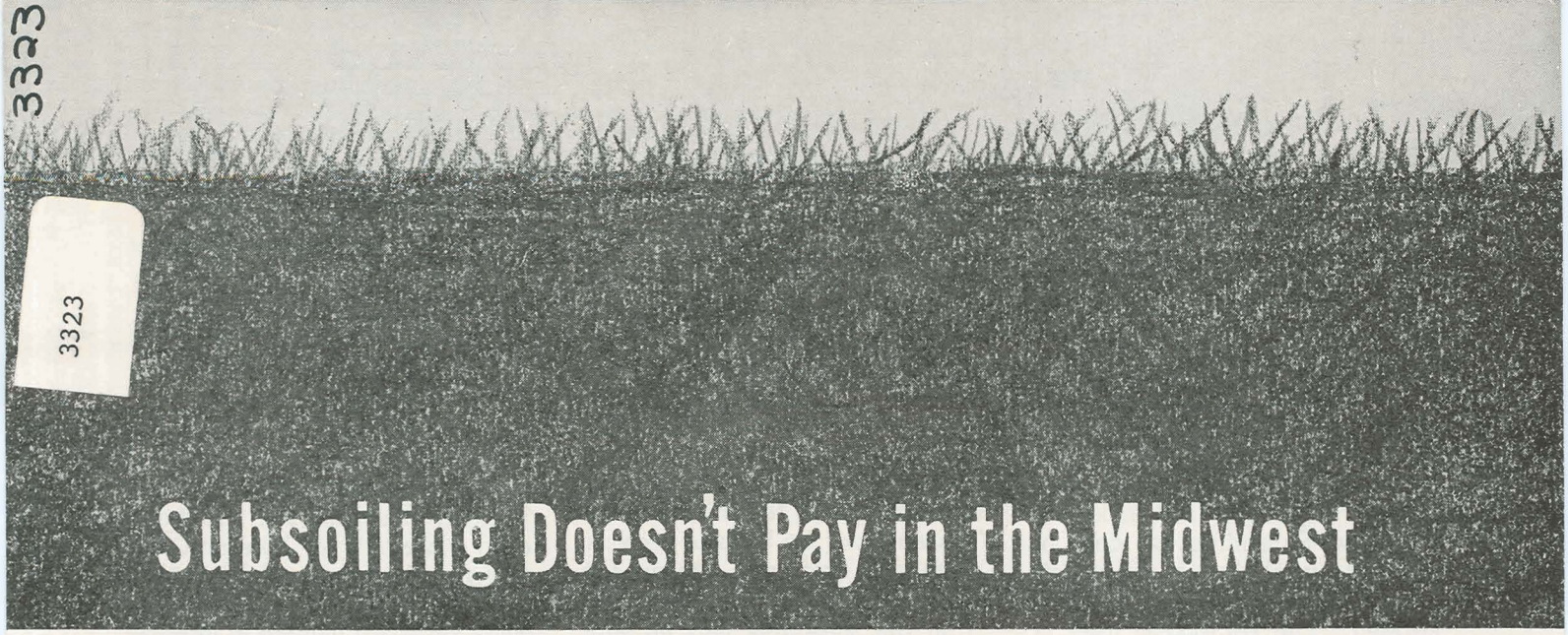


# Subsoiling Doesn't Pay in the Midwest

Interest in subsoiling comes and goes. But studies in three midwestern states show that deep tillage and deep fertilization seldom pay as compared with good fertility and management practices at usual plow depths.

*by W. E. Larson, W. G. Lovely and V. C. Jamison*

THERE ARE few benefits gained from deep tillage or deep fertilizer placement in the Midwest. There sometimes is a yield increase with deep treatment, but the value of any yield increase must be looked at *in terms of the increased cost.* And the cost of a soil treatment increases greatly with the depth of the treatment.

In other areas of the United States with different soil and weather conditions, subsoiling occasionally has given large crop increases. Under extreme conditions, subsoil treatments in these areas can make the difference between a good crop and a failure. But it's doubtful if expensive subsurface treatments can give economic returns for crops in the north-central states as compared with good fertility and management practices for the normal or surface plow layer.

Interest in deep tillage, however, comes and goes. A favorable report from some locality stimulates interest over a wide area. When test results show little or no advantage over normal methods, interest dies out—at least for a few years. Then, another favorable report of results under certain soil and weather conditions revives interest.

## Subsoil Tillage . . .

The conditions that favor tillage below the normal plow depth of 6-8 inches are limited to certain soil and cropping situations and, often, specific weather conditions. For example, very compact layers tend to develop under machinery traffic on some of the medium-textured soils in the Mississippi and Louisiana delta land. When this "pressure pan" is broken by deep tillage in the fall, moisture storage from winter rainfall may be improved, and yields of the following crop may be increased. But the expensive treatments must be repeated often because the effects are only temporary. And soil moisture and weather conditions must be favorable for effective results.

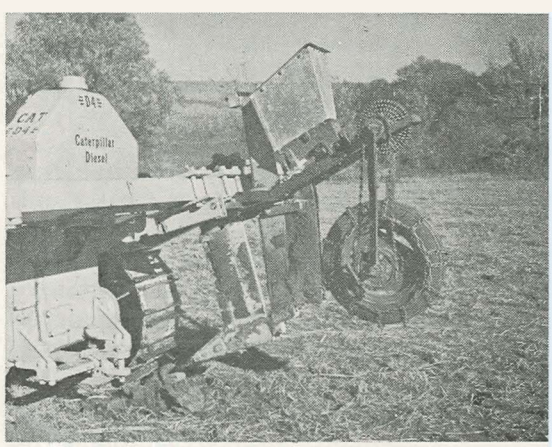
In the Midwest, where soils freeze regularly to depths of 3-5 feet or where drouth may cause shrinkage and subsoil cracking, research shows little benefit from deep tillage. Natural forces may often change the subsoil structure more than can be done by a deep tillage.

## Research Results . . .

Research on subsoil tillage alone or in combination with deep lime or fertilizer placement has been conducted in Iowa, Illinois and Missouri. The results tend to confirm also that expensive subsoil fertilizing generally isn't justified when compared with good fertility and management practices for the surface plow layer.

Here's a brief review of the experiments in the three states.

**Iowa Findings:** Sites for the Iowa study were chosen in areas




Repeated studies have shown few benefits from subsoiling in the Midwest, and costs of deep treatments increase greatly with depth of the subsoil treatments.

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where there was considerable local interest and were selected to include a wide range of major soil types. The treatments compared different depths of tillage with and without applications of fertilizer in the tilled zone. The soils tested were Ida, Marshall, Galva, Edina and Grundy silt loam and Webster-Glencoe silty clay loam. Fields were subsoiled at 40-inch intervals, and corn rows were planted right over the subsoiled channels. Subsoiling was done in the fall on all but the Ida soil (which was subsoiled in early spring). The equipment used is shown in the photo.

While there was much local interest in the tests, earlier research indicated that few benefits should have been expected. The soils studied have no severely compacted layers in the root zone within reach of the subsoiling tools. As expected, subsoiling alone resulted in no meaningful changes in corn production in most cases. Subsoiling at 24-inch depths decreased the yield on Edina silt loam by 9.7 bushels per acre in 1956 and by 6.4 bushels per acre on Grundy silt loam in 1957.

For the deep fertilizer tests, the fertilizer was distributed in a band in the bottom of the slot in Ida soil and from the bottom to 4 inches above the bottom of the slot for the Webster-Glencoe soil. The result: Yields were better when the fertilizer was merely plowed down than when deep placed. In one case, yield decreases from deep placement as compared with plow-depth fertilization still were apparent 3 years after application.

**Illinois Results:** Subsoiling trials were made on several soils in Will and Kankakee counties. Chiseling 10-12 and 16-18 inches deep was compared with ordinary plowing. An implement similar to the one used in the Iowa tests was used at 40-inch intervals.

In experiments at eight different locations, 12-inch subsoiling resulted in 5 increases and 3 decreases in yield, and 18-inch subsoiling resulted in 7 increases and 1 decrease in yield in the first year after subsoiling. Statistical analysis, however, indicates that only at one of the locations was there a good chance that the increase was actually due to subsoiling and not to other possible differences. The second year after treatment there were 2 yield increases and 4 decreases from 12-inch subsoiling and 3 increases and 3 decreases from 18-inch subsoiling, but only one of the increases was statistically valid. The average increase for all treatments at all locations was 3.6 bushels per acre during the first year. During the second year the average yield from the subsoiling and no subsoiling treatments was the same.

Consequently, even for the same soil type, benefits from subsoiling can be expected only part of the time and at a few locations. These probably will occur where there are severely compacted or cemented layers in the root zone within reach of the subsoiler.

Deep lime and fertilizer experiments also were started in Illinois —on a claypan soil near Carbondale in southwestern Illinois. Phosphate and potash fertilizer were used according to soil tests and also at several times the requirements indicated for the upper 3 feet of soil. The lime and fertilizer were mixed in the soil to depths of 9, 18, 27 and 36 inches.

Preliminary results showed that, even though corn rooting was influenced, yields weren't affected by depth of mixing. Lime and fertilizer increased yields regardless of the depth of mixing, and mixing the fertilizer in the topsoil was as effective as mixing in the subsoil layer. Higher rates of fertilization above minimum requirements didn't make much difference either—except in the surface where they tended to lower yields. It's still too early for a report of any residual effects of these treatments.

**Missouri Tests:** Subsoiling alone appeared to be detrimental in these studies conducted on a claypan Mexico silt loam near McCredie in central Missouri. This is probably because subsoiling caused some of the acid subsoil to be mixed with the fertile topsoil. Only when lime and phosphate fertilizer were mixed with the subsoil or placed in subsoil slots was there any evidence of benefit. This method improved the rooting and growth of sweetclover and resulted in a small increase in corn and soybean yields. But it didn't increase the yields of small grains.

After a second treatment, the plots were seeded to alfalfa to study the residual effects on hay yields from subsoil shattering and deep placement of lime and fertilizer. Though small, the yield increases over the next 3 years were consistent enough to indicate that deep treatment of acid subsoils may have some benefit for deep-rooting legumes.

Four methods of placing or mixing lime alone and lime plus concentrated superphosphate were tested, starting in 1954. Lime was applied at 8 tons per acre alone or in combination with 400 pounds of 45-percent phosphate. Corn was grown on one set of plots; alfalfa on another.

Placing lime on the plowsole gave little benefit to corn. Small yield increases resulted from placement in the subsoil slots and from a double plowing method. But the increases were too small to be of practical value. The concentrated superphosphate had little effect or tended to lower yields when placed with the lime.

In the tests with alfalfa, lime alone placed in the subsoil by these methods had little benefit. In combination with superphosphate, placement in the more closely spaced slots (21-inch intervals) gave a small (0.09 ton per acre per cutting) hay yield increase.

## In Total . . .

The results of these and other studies indicate that the benefits, when they occur, from deep tillage and deep fertilization are variable and relatively small in the Midwest. Considering the expense of the treatments, it's doubtful whether subsoiling treatments can be justified in this area —particularly as compared with the use of good fertility and management practices in the usual plow layer.

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